GRA Contribution to Power Positions Project

ANNEX B

ENVIRONMENTAL RESEARCH AND ITS IMPLICATIONS TO LONG-RANGE POWER POSITIONS

Introduction

This paper outlines the importance attached by Soviet science and technology to the study of the physical environment of the entire earth as an element in the power struggle as compared with that of the Free World. The discussion of necessity is limited to a conceptual and qualitative description since methodology is lacking for developing quantitative measurements of the rate of progress in the accumulation of physical environmental observational data or a comparative index of Bloc-Free World capabilities for forecasting and predicting the occurrence of physical phenomena. It is concluded, however, that a serious disparity of decided disadvantage to the Free World appears to be developing.

The paper is intended to be a diagnosis only. As such, it does not claim or imply that Soviet objectives and methods are superior or inferior to those of the Free World in an absolute sense, nor does it imply that the West must adopt Soviet methods to avoid or eliminate the disparity in the knowledge of the physical environment. It is the thesis of this paper that Soviet objectives and methods have evolved into systematic and comprehensive programs for research on the basic physical environment that may give the Soviets a time advantage in the development of a capability to forecast or prognosticate the occurrence of physical environmental phenomena, whether for economic competition or for military operations.

I. The Nature and Advantages of the Soviet Approach to Physical Environmental Research

The basis of Soviet science rests on the purposefulness and comprehensiveness inherent in dialectical materialism, which is defined as "the manifold study of the development, the universal relationship, and mutual interdependence of phenomena." Using Marxist dialectical methods, phenomena are analyzed, generalizations are formulated, and general laws are sought out to which these phenomena are subordinate. This provides "scientific foresight" which is "able to solve any practical task successfully." Thus, being able to foresee events, science becomes a "tool with which man can make practical changes in the world* -- a tool for the subjugation of the forces of nature and society to the interests of society."

Such "scientific foresight" -- derived from successes in atomic physics whose "purely theoretical prognoses" of successful atomic explosions -- led to the creation of atomic bombs and atomic technology. Such control of the microcosm was reiterated as a goal for Soviet science as a whole by the late Academician Igor Kurchatov, leading Soviet nuclear physicist of his time. His address to the XXI Party Congress in 1959 concluded with the following words: "The scientists of our great motherland will, together with their party, with the entire Soviet people, labor unceasingly to make man the true master of nature in communist society." The same concept was reiterated by Major General

* On this premise, the controversial Lysenko theory -- that man-induced changes in genes can become hereditary -- is not the pseudo-science and an inexplicable paradox that is difficult to reconcile with the high scientific standards in other fields. To the Soviets, this theory is not too inconsistent with the goals of early nuclear research and experimentation.

G.I. Pokrovskiy in commenting on the 1960 Soviet Pacific missile tests when he said: "The conquest of cosmic space is neither the sole objective nor the fruit of 'pure' science divorced from the requirements of life. It is the next logical stage in the conquest of nature by man." The application of these concepts to the world between the microcosmic and macrocosmic -- the mesocosmic -- was also spelled out by Yevgeniy K. Federov, geophysicist and leading Party spokesman in the field of geophysics. He describes the objectives of studies concerning the Earth -- geology, geography, geophysics, geochemistry, geodesy, etc. -- as providing for society the best possible means of utilizing the favorable and useful characteristics of nature and, at the same time, of searching out means of defense against harmful and unfavorable elemental phenomena.

The application of systematic principles in the formulation of policies for the discovery and development of natural resources, the solution of problems associated with the harsh Soviet physical environment, the improvement of land use, and the development of virgin areas in regions of precarious climatic conditions was reflected in the early implementation of comprehensive surveying and mapping programs -- topographic, geologic, hydro-geologic, geographic, soils, vegetation, etc.

Out of these motivations and policies has emerged a vast, effective scientific structure that has become the envy of more than one scientist in the US. Today this structure is capable of increasing its collection programs, incorporating data collected by other countries, and subsequently undertaking processing of data in association with research studies. The implications of the vastness and the purposefulness of this structure also has worried US scientists -- some to a point of disillusionment -- in government and in academic circles because it is unmatched anywhere in the Free World.

Communist ideology, directed toward the broad objective of increasing mastery over natural forces, has also led to the distinctive development and widespread use of the "collective research" method. This method brings a variety of disciplines to bear on a single research problem. Whereas in the US the team method has been developed almost exclusively -- and very effectively -- for industrial research, the Soviets apply the method to basic research. The combination of directed purposefulness, concentration of attack, and large size gives the Soviets a long-range time advantage in the achievement of their objective of forecasting the occurrence of natural phenomena and developing mastery over them. On the other hand, the basic research in the Free World is dependent upon the motivations of individual scientists, usually within the confines of their own specific disciplines.

It would follow that, given more or less equal forms and levels of weapons development, military superiority would accrue to that nation best able to forecast and control the behavior of physical environmental phenomena.* Recognition of the military application of such capability was clearly stated by Pokrovskiy as follows: "At the root of the

* Pokrovskiy states that superiority over an enemy is dependent on three factors: (1) superiority in matériel; (2) higher ability to use available matériel; and (3) ability to cope with intricacies of contemporary technology. He further notes that absolute superiority is unattainable if the development of science, of technology, and of the economy is maintained at approximately the same level in opposing power blocs.

development of military technology lie mankind's achievements in the field of understanding the objective laws of nature and in the field of understanding the means of controlling the forces of nature" and "Deep scientific foresight is exceptionally important in military affairs."

The task of developing the capability to forecast and control is conditioned fundamentally by certain unique aspects of physical environmental data. First, unlike many other fields -- in which data are observed, analyzed, and manipulated under laboratory conditions within finite controllable limits -- earth-science data, by and large, are observable only in the vastness of the earth as a whole, where controllable conditions for experimentation are essentially impossible. Second, each point on the earth's surface or in space has properties or characteristics that are unique unto itself. In the final analysis there are no substitutes for the observational data, which must be observed at each given point.

This aspect is of especial importance in the power struggle if observational coverage is limited by inaccessibility -- either physical, as in the case of polar regions, or political, as in the case of the Sino-Soviet Bloc. The goal of all of the earth sciences, therefore, must be the fullest possible data for the earth as a whole, its seas, and the atmosphere. The problem of data collection is especially complicated in the case of dynamic geophysical sciences, which require (1) continuous observations over a period of time long enough to include all representative variations, and (2) synoptic observations to provide the simultaneous records of a dynamic phenomenon over wide portions of the earth's surface.

The collection of data on an ever-expanding world-wide basis, therefore, becomes an essential, explicit goal in order that (1) analysis may be undertaken, (2) generalizations derived, (3) discoveries of objective laws formulated, and (4) ability to forecast or predict the occurrence of physical or environmental phenomena be achieved at a level of sophistication comparable to that of nuclear physics or orbit prediction in astronomy. The development of such programs is truly monumental in terms of time and space, and accomplishments are difficult to measure. Yet the large size of the Soviet research apparatus and its expanding world-wide activities indicate an inexorable march toward this goal. At what point superiority over the Free World may be achieved it is impossible to state. Although the rate of progress toward the ultimate Soviet objectives is not measurable quantitatively, some indication of the initial advances can be derived from a survey of Communist physical environmental research undertaken, first, to meet domestic requirements and, second, to attain world-wide coverage. The summary that follows treats only a few of those more significant fields of research for which available data are sufficient to provide some quantitative measure of progress or descriptive illustration on Soviet advance toward the ultimate goals.

II. Progress in Physical Environmental Research

A. Geodesy and Topographic Mapping

1. USSR

Although various programs for surveying and mapping are undertaken by a large number of ministerial or so-called production enterprises, the activities of all are integrated into a uniform program and are implemented through unified specifications. Particularly noteworthy is the vertically-integrated development in the Soviet Army of all phases of surveying and mapping activity -- among them field parties, all forms of map compilation and production, scientific research, and education, including the granting of doctorates to military officers. As a result of the heavy investments in education, which include a 5-year course in higher geodesy*, the Soviets are estimated to have developed a roster upwards of 6,000 engineers engaged in geodesy, photogrammetry, and cartography for topographic mapping**. In this production the Soviets have not only adopted to a remarkable degree the experience, methods and instrumentation of the Free World to a mass program, but they have also developed instruments and techniques of their own, including super-wide-angle lenses to provide the widest horizon-to-horizon coverage for use in their aerial mapping. As a result, in the space of 4 decades the Soviets completed the coverage of their entire country (2-1/2 times the size of the US) at 1:100,000, involving more than 20,000 individual

* In the period 1937-1955, at least 42 Doctorates of Technical Sciences in Geodesy were granted. Up to 1955 no such advanced degrees were being granted in the US.
** The US National Scientific Register, as a result of its 1956-58 survey, lists 1,375 classed as Engineers: surveying, mapping, and photogrammetry.

sheets. Such an achievement is still considered incredible by many Free-World map specialists. In twice the span of time the US has mapped less than one-half of its area.* Although the geodetic standards for much of the Soviet coverage -- chiefly for Siberia -- are lower than those for more highly developed areas, the Soviets have embarked on a program to extend triangulation into areas such as Siberia and the Arctic** by the end of the Seven Year Plan. Topographic mapping is now being concentrated on coverage of all developed areas of the USSR at 1:25,000, and of the more important areas at 1:10,000. Despite the fact that some of the European Satellites have had a good topographic mapping foundation, the Soviets in 1952 imposed an extension of their own geodetic and topographic mapping system into the European area by forcing a revision of all the national systems. The program is now in the final stages of completion.

The Soviets have taken leadership in the development of geodetic gravimetry, which dates back to 1932, when the Soviet Council of Labor and Defense decreed the undertaking of a general gravimetric survey of the entire USSR that would establish a minimum of one observation per

* The Soviet publication, Geodesy and Cartography, No. 2, 1959, states that in many aspects Soviet geodesists and cartographers have already surpassed the geodesists and cartographers of the US. Notwithstanding the fact that the US is much smaller in area and environmental conditions are much more favorable, American geodesists and cartographers have covered no more than 40 percent of their country. The completion of mapping at 1:25,000 and 1:62,500 is aimed for 1973. Soviet geodesists have already covered their country at 1:100,000 and claim that they will not fall behind in their larger scale mapping.
** The bulk of the effort will be concentrated in regions of Eastern Siberia, the Urals, Far East, and Central Asia. By the end of the Seven Year Plan in 1965, 80 percent of the topographic-geodetic work will be concentrated in the eastern and northern regions.

1,000 square kilometer (22,000 points). The survey has been of value both as a reconnaissance framework for resource exploration programs and for the development of unique and original research aimed at simplifying the problem of geodetic adjustment related to the long meridional extent of Soviet mapping. Out of the gravimetric research, however, the Soviets have devised techniques which, if they continue to gain free access to world-wide gravity data of their own and other countries, will give them the means for easily establishing geodetic positions in any unsurveyed area in the world without need for resorting to triangulation.

2. Communist China

The Chinese appear to have developed their own program, but with acknowledged Soviet assistance of unknown amount. Progress appears to have been remarkable. Unlike the European Bloc countries, China established its own system of coordinates, Peiping 1954, with vertical control based on the Yellow Sea vertical datum. It is claimed that by the end of 1957 "approximately half of the territory of the country was well provided with modern high precision ... first-order triangulation and high-precision levelling. ... A considerable part of the country had been covered, by the end of the first five year plan (1953-57), with new state topographic surveys on scales of 1:50,000 and 1:100,000." The Chinese plan calls for completion of first-order triangulation in 1961, and for completion of the topographic map of all of China by 1967. Three scales are to be used: 1:25,000 for the more important areas; 1:50,000 for the remainder of the densely populated and economically developed areas; and 1:100,000 for the desert, mountain and high plateau areas. Like the Soviet maps, the Chinese map series are being pushed to completion at the expense of omitting some details. After the first coverage is completed (1967), the maps are to be revised to incorporate greater detail. The personnel employed in this work now number more than 20,000.

B. Geology

1. USSR

From a revolution-depleted roster of 50 geologists in the Geological Committee and a total of 150 in the entire country, the number increased by 1936 to 1,690 geologists in the geological survey and 30,000 workers and service personnel. In 1956 the geological activities of the USSR were staffed by 54,000 engineer-technicians*, of whom 28,000 had advanced degrees, and 350,000 were workers and service personnel. Drilling rigs in operation had increased to 13,000. About 98 percent of the USSR was covered by geological mapping at 1:1,000,000, and more than 65 percent by maps at the larger scales (40 percent is at 1:200,000 or larger scale). In the US, after more than 80 years of continuous activity, only about 15 percent of the country was covered by geologic maps at 1:62,500 or larger (excluding Alaska and Hawaii) and about 50 percent at 1:125,000 to 1:250,000. The huge Soviet investments have brought significant benefits, which are best epitomized by the high degree of self-sufficiency achieved in raw materials and by the tremendous and rapid industrialization of the country. A quantitative illustration of benefits that have accrued to

* The nearest US figure available for comparison according to the National Scientific Register is 9,514.

the Soviet Union from its geologic programs is the recent revisions in the estimation of world coal reserves in which Soviet proportion has increased from 21 percent to about 50 percent.

Current Soviet geological research is being directed toward a continued intensive search for raw materials under the pressure of diminishing reserves and an expanding industrial economy. For example, one program calls for the compilation of metallogenic maps in three scale categories: general metallogenic maps of the USSR at 1:1,000,000 and smaller; medium-scale prognostic-metallogenic maps of large ore provinces at 1:1,000,000 to 1:200,000; and large-scale prognosis maps of individual ore regions at 1:200,000 and larger. The magnitude of this effort is illustrated by the fact that in 1959 alone 620 topics* were in work by various geological research organizations. The compilation of small- to medium-scale (1:1,000,000 through 1:200,000) prognosis maps of mineral distribution is one of the specific tasks of the Seven Year Plan. Work on this problem is said to be lightened by the geological mapping that has already been done or is underway. By 1965, 25 percent of the geological surveying will be undertaken by geophysical methods -- gravimetric, aeromagnetic, seismic, radiometric, electro-exploratory.

2. Communist China

Geologic exploration, like geodetic surveying, has also been emphasized in CHICOM programs for the development of the country. The magnitude

* Direct comparison of this figure with corresponding figures for the US proved to be impossible. However, the disparity is suggested by a reliable US estimate of the relative efforts of the US and the USSR in the field of metallogeny. The estimate indicates that, numerically, the scientific manpower difference is at least 1:10 and may be upward of 1:50 in favor of the USSR.

of the effort is shown by the increase in the number of people working in the field of geology during the last few years -- from several hundred to 400,000, of whom 21,000 were trained geologists. There are now 3 large geologic institutes, 25 technical schools, and 22 universities with faculties of geology and a total enrollment of 36,700. Geological exploration is conducted not only by provincial geological administration (a number of which have their own scientific research institutes), but also by 10 scientific research institutes in the Chinese Academy of Sciences and a number of units in production ministries. The ambitious topographic mapping program discussed previously is being used as a base for geological mapping, thus greatly facilitating and speeding the progress of surveying while providing a sound scientific foundation. By 1958, the Chinese claimed that 22 percent of the country was covered at 1:200,000; nearly 7 percent at scales larger than 1:200,000; and 13 percent at 1:1,000,000 to 1:500,000.

C. Arctic Research

1. USSR

The development of Soviet Arctic research has played a significant role in the expansion of Soviet physical environmental research from goals designed to meet domestic economic requirements to objectives requiring research on a global scale. Early Soviet Arctic research -- dating back to 1921, when Lenin's decree founded the Floating Marine Scientific Institute -- was directed primarily toward a gradual development of the Soviet economy. In 1932, however, with the formulation of plans to open up the Northern Sea Route, the development of the Arctic regions became a major objective. The initial expansion of Soviet shipping proved overambitious. A series of mishaps arising from inadequate information on the harsh physical environment culminated in a number of disasters in 1937, demonstrating the basic need for reliable forecasting of weather, ice conditions, currents, etc.

Realizing the interrelationships of various phenomena, the Soviets initiated a number of basic research programs designed to broaden substantially the coverage and increase the volume of environmental data available. Unique methods were developed to collect the necessary information; research facilities were expanded or new ones established to undertake studies to improve the forecasting required for shipping operations and eventually to lengthen the shipping season to 6 months. Data collection was extended deep into the heart of the Arctic Basin. In 1937 successful operation of NP-1 demonstrated the value of drifting stations. The ninth in a series of drifting stations is now being set up. Aircraft were developed as "flying laboratories," instrumented to make simultaneous weather and ice observations from the coast northward into the interior of the Arctic Basin. Instruments for weather and ice observations were installed on ice-breakers, some being detailed explicitly for additional studies of the pack ice. Scientific teams, combined with the operations of flying laboratories, were landed at numerous otherwise inaccessible areas to make observations of natural phenomena from ocean bottom to the significant elevations in the lower atmosphere. By 1954 the Soviets evolved a comprehensive range of programs that had developed to the point where each functioned at a routine level. Polar stations, drift stations, and aerial ice-reconnaissance surveys operate the year round, and additional hydrographic, oceanographic, geologic, and glaciologic expeditions operate on a seasonal basis.

The Soviets can now rightfully boast that they have more information on the Arctic Basin than has any other nation in the world. They are now experimenting on a television system of ice observation that transmits data to central points, where they will be correlated with other weather information in the preparation of synoptic ice and weather charts.

2. US

US research in the Arctic Basin did not begin until after World War II. The first drifting station, T-3, renamed Bravo, was initially occupied in 1952-54, reoccupied briefly in 1955, and again in 1957. Two other drift-floe stations were established, both of which had been abandoned by February 1960. The use of submarines, which was initiated by the US, offers unusual opportunities for research, provided that systematic coverage is developed. Another unusual and significant US contribution has been the maintenance since about 1947 of daily ice-reconnaissance and weather flights conducted over the Arctic Basin. Although the US has outpaced the Soviets in the development of one new research method and has maintained continuity of observations in its daily flights, US programming as a whole suffers from a lack of comprehensiveness and continuity. For example, although T-3 is still occupied, the equipment from the other two stations is in storage, where it will remain unless or until an official requirement authorizing a new launching is issued. Whether submarine work initiated will develop into a long-range program is not yet certain. On balance, the Soviets have a superiority in Arctic research in terms of comprehensiveness of research, extent of coverage, and continuity of observations.

The approaches of the US and the USSR differ fundamentally. It can be stated categorically that Soviet Arctic research is systematic, integrated, and planned for indefinite continuity. US research, on the other hand, is primarily a military activity, subject to vagaries of the annual budget cycle and shifts in military requirements. Although Soviet activity is directly applicable to the needs of the Northern Sea Route, the fact remains that the Soviet program yields physical environmental data which are also utilized by scientific institutes for Soviet long-range objectives.

D. Soviet Competence in the Earth Sciences

It would not be enough merely to have a voluminous effort in data collection if the competence of the work based on it were less than adequate. The most recent NIE 11-6-59: Soviet Science and Technology, rates the Soviets in general very high not only in geodesy and geology but also in various other fields of earth science.

1. Polar geophysics. The Soviets are world leaders in this field. Their advancement into Antarctic research is comprehensive, primarily to advance their coordinated studies of the earth as a whole.

2. Meteorology. Work in weather and meteorology is competent. Research in weather modification and basic cloud physics has paralleled work done in the West, and the Soviets will strive to develop additional weather control techniques. Extensive control of weather, however, is not expected. Significant advances are expected in Soviet upper-atmosphere and solar-terrestrial relationships.

3. Oceanography. Soviet research has been more extensive than that of other leading nations. The Soviet work is of high quality in polar areas, and in marine biology and marine geology. Over the next decade Soviet forecasting of the thermal structure of the ocean will produce applicable results for increased competence in ice forecasting, for predicting sound-range conditions, and for meteorological applications. As yet the Soviets are behind the US in chemical and dynamic oceanography, and instrumentation, although improvements in these can be expected.

4. Seismology. Soviet research is intensive and well supported with adequate facilities. The seismic [station] network has increased from 20 to over 100 since 1945, and the equipment is excellent. Due to the scope and intensity of Soviet research it is likely that Soviet capabilities in many areas of seismology will exceed those of the US in a few years.

5. Geomagnetism. Although the USSR has not yet matched the average quality and achievement record of the US in the field of geomagnetism, it is rapidly moving toward that goal. The Soviet Union now leads the United States in number of research facilities and leads the entire Free World in magnitude of its observational effort. In the more theoretical aspects of geomagnetism, however, the West has attained a higher level of competence.*

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III. International Aspects of Soviet Physical Environmental Research

A. Entry into International Programs

It is significant to stress that Soviet policy has traditionally isolated Soviet earth scientists from foreign contacts. It has also been a policy, laid down by Lenin himself, to capitalize on the best and most advanced of "bourgeois" scientific developments. For nearly 3 decades the Soviets have tried to maintain a one-way flow of information. Two significant exceptions to this policy were the early Soviet membership in the International Meteorological Organization and participation in its subsequently sponsored project, the International Polar Year (IPY), 1932-33, both of which involved an exchange of data.

Whether or not the Stalin regime was the cause of such isolation is uncertain. In any event, the Soviets made their biggest break with past policy by their decision to participate in the International Geophysical Year (IGY) Program and, shortly afterward, to become members of the International Union of Geodesy and Geophysics. When the program of the Soviet Union was unfolded it proved to be one of the most comprehensive and ambitious of all national programs. In the field of oceanography the Soviet effort, judged by the number of ships, was the largest. With the successes of their artificial-satellite program the Soviets have made great strides in achieving recognition equal to that achieved by the US in many scientific fields and superior in some (e.g. oceanography, satellites).

After the IPY the Soviets retreated into isolation. This policy was reversed after the IGY, and the Soviets manifested considerable initiative in their efforts to secure continued IGY cooperation into the IGC -- International Geophysical Cooperation. The work of the IGC is now being conducted through various special committees of the International Council of Scientific Unions (ICSU), which now include Special Committees on Antarctic Research, Outer Space, and Oceanography. The Soviets are also members of other international organizations such as the International Geological Congress, the International Astronomical Union, and the International Astronautical Federation. In addition, they have also embarked on a program of exchanges of scientists, the major theme being coordinated programs and exchange of information. From the very beginning the Soviets undertook programs (particularly in Antarctica) in geology, geography, mapping, resource exploration, air and sea navigation research, and preparation of pilot handbooks. In other words, the Soviet interests were wider than those of the IGY and for a much longer duration than the 18-month period of the IGY. Soviet world-wide research seems to be here to stay.

B. Aid to Underdeveloped Countries

The list of Soviet projects (following p. 27) in various international aid programs includes those which, by their nature, would be adaptable to the collection of physical environmental data. Whether these projects were intended to be so used is immaterial. Some of the programs are for comprehensive geophysical or geological surveys. Other smaller programs are also important as providing opportunities for collecting unique exploration or mapping data. Another significant though less suspect activity is the training of indigenous personnel (Iraq) or the construction of educational establishments (Guinea) and research institutes (Indonesia). These afford opportunities to ensure, among others, two objectives pertinent to future scientific relationships: (1) systematic training in the dogma of dialectical materialism, and (2) training in Soviet scientific methods and techniques. The training in dogma is designed to secure converts to the erroneous belief that only Soviet science performs on the principles of the scientific method. Such converts become not only disciples of the "cause" but also willing contributors of scientific data to the USSR. The training in Soviet methods and techniques provides for greater homogeneity in the data collected among nations.

There are indications that earth scientists may become the "bird dogs" of future aid proposals, as was suggested in 1959 by the formulation of a Soviet Association of Friendship and Cultural Cooperation with Latin America. Two of the four vice-presidents are outstanding Soviet physical geographers. The unusual appointment of geographers to interpret Soviet life to Latin America suggests that they are being used in establishing contacts with other geographers, strengthening the flow of geographic data to the USSR, and possibly assisting in the formulation of aid programs.

The almost universal inclusion of terrestrial surveys and mapping in aid programs suggests a Soviet determination to establish in other countries the same systematic approach to the raising of the productive capacities that proved so effective in the USSR. Moreover, such support is invariably given to socially-owned enterprises that the Soviets hope to lead eventually to Communism.

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IV. Current and Future Disparities in Knowledge of the Physical Environment

The Sino-Soviet Bloc possesses certain advantages over the US by virtue of a long-standing policy of withholding various types of basic environmental information concerning the vast area of the USSR, comprising one-sixth of the earth's surface, plus Communist China with an area larger than that of the US. This is a deliberate policy intended to make secure the national defense of the Soviet Union.

The principal materials withheld include all postwar sheets of the topographic map coverage (1:500,000, 1:300,000, 1:200,000, 1:100,000, 1:50,000, 1:25,000, 1:10,000, and larger scales) and most of the sheets of even the 1:1,000,000 series; all postwar geodetic catalogs of the latest unified geodetic system, all gravity catalogs, all detailed catalogs of geomagnetism; all geologic map series at scales larger than 1:1,000,000 and all but about one-third of the 1:1,000,000 series. Despite its membership in the International Association of Geodesy (IUGG) the USSR is withholding even information on triangulation and levelling networks. When confronted directly with the request for gravity information, the Soviets resort to the lie in order to evade disseminating such information. On the basis of information from one aid-recipient country, it is believed that the Soviets attempt to establish comparable security protection over survey data of all aid-recipient countries.

While such information was being withheld, the Soviet Union, with its vast and elaborate system of collecting and processing of foreign data, has probably collected most, if not all, of the available information on the rest of the world.

Although the IGY was established on the principle of free exchange of information, the fulfillment of this performance is not subject to review. Whereas the Soviets acquired a tremendous amount that is of strategic value, much of what they have released has been chiefly of prestige value or of a nature that has no direct military application. The materials mentioned above have not been made available either because they predated the IGY or because, as in the case of the topographic and geologic maps and the geodetic and gravity catalogs, they were not substantive parts of the IGY programs. This was explicitly confirmed in 1956, when the Soviet scientists, in a generous gesture of cooperation, disseminated declassified reports on the Arctic, but the sections concerned with gravity and geomagnetism were cut out. Many of the data released are known to be given in generalized or processed form and not as raw data. The Soviets are also known to be withholding some of the communications codes of their own earth satellites, making it impossible for other nations to decode the transmitted information. So long as this condition is allowed to continue, the Western World, with its traditional policy of free exchange of information, will find that the Soviets are accruing an increasing advantage in the development of knowledge concerning the physical environment. The assessment of the magnitude and measurable consequences of such disparity has not as yet been specifically assessed.

V. Some Aspects of US Science Problems

Whereas Soviet science from the very beginning was given a top-level role in the planning of research and development for the national economy, US science did not receive comparable recognition until World War II. The service of US science was performed essentially through the National Academy of Sciences-National Research Council on an individual project basis. Basic research was primarily centered in the universities, where research is highly individualized in consonance with the traditional role of the university in the search for truth.

In periods of major national crisis, as in World War II, large sums of money were supplied to support military needs. Realization of the inadequacy of the World War II spurt led to the establishment in 1949 of the National Science Foundation, whose function is to provide Federal assistance in support of basic scientific research. In 1957, Soviet earth-satellite success aroused a sense of crisis and inquiry in the US. Even now, however, "thoughtful persons differ over the direction we should take" to strengthen the goals and structure of US science and education. Further deficiencies are indicated in the admonitions of the President's Science Advisory Committee report, Strengthening American Science, released December 1958: "If Federal support is halting and erratic, if it emphasizes mechanism and hardware to the neglect of fundamental understanding ... the net result could be an impoverished science." The report advises that "the interplay between fields, producing unexpected results, is at the heart of technical progress [compare with p. 2 -- definition of dialectical materialism]". The report further states that research programs should have great breadth and scope; that ways must be found to recognize the importance of stability and other long-term goals; that the need for fully integrated policies to support public and private laboratories must be recognized; and that the Federal government should try to pull together the policies of different departments to integrate and reconcile them as a whole and take notice of the problem of research planning by universities that get extensive support but on a single-project basis. Thus one of the functions of the Federal Council for Science and Technology (March 1959) concerning the nation's overall advancement in science and technology, was "to identify research needs including areas of research requiring additional emphasis, to achieve more effective utilization of the scientific and technological resources and facilities of Federal agencies, and to further international cooperation in science and technology." Nevertheless, in the 1959 NSF report, Dr. Waterman cautions that less than 8 percent of all research and development funds went into basic research.

VI. Long-Range Prospects

The Sino-Soviet Bloc can be expected to continue its policy of expanding its own world-wide collection of data and of encouraging international scientific programs to provide additional data. At the same time, the Bloc will continue its anti-liberal policy of withholding as much information as possible and of releasing only those data that have little direct military value as a kind of pay-off to keep international programs from drying up. Soviet physical environmental research has demonstrated its effectiveness and gained recognition for its basic contributions to (1) Soviet industrialization and other national economic development and (2) the support of military operations during the past wars. In the course of these activities, Communist science has reached a high level of capability and sophistication, which now can be used for the broadened phase of world-wide research and which is essential if Communism is to achieve its long-range objectives. Moving out into world-wide research, Communist science serves to fulfill its scientific requirements and at the same time to contribute toward the intermediate goal of advancing Communism. This is accomplished in two ways: (1) participation in international scientific research, which not only increases the collection of data but also affords an opportunity to show off Communist science; and (2) support of Soviet foreign aid programs in underdeveloped areas, which not only provides still another opportunity for data collection but also benefits the recipient countries by advancing their systematic resource surveying and mapping projects. International participation further serves

Communist purposes in the struggle to win over men's minds by the subterfuges of identifying effective scientific method with dialectical materialism as the only ultimate means for human intellectual development and, at the same time, of portraying bourgeois science as ineffective, sterile, and employed exclusively in the interest of profiteers and warmongers.

The Soviet policy of withholding basic physical environmental data, on the one hand, while reaching out for the freely given information, on the other hand, places the Communist Bloc in a superior position. The inability of the Free World to overcome the resulting disparity in data procurement except by extremely expensive and time-consuming techniques has created a serious time lag that is not likely to be adequately overcome for years to come. As a consequence of their purposeful, dynamic, and highly integrated physical environmental research, the Soviets could retain significant scientific superiority well into the future.

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Underdeveloped Countries Receiving Sino-Soviet Aid
Adaptable to the Collection of Physical Environmental Data

Recipient Country	Aid-Granting Country	Date Extended Year	Date Extended Month	Projects Receiving Aid
Afghanistan	USSR	1956	January	Naghlu hydroelectric project, Sarobi Pul-i-Kumri II hydroelectric project Darunta irrigation project, Jalalabad Salang Pass road
		1958	July	Aerial mapping of northern Afghanistan (exclusive of petroleum surveys)
		1959	May	Kushka-Herat-Kandahar road construction
		1959	---	Geological Survey
Guinea	USSR	1959	---	Technological Institute (2,500 students) Geographical survey
	Poland	1959	---	Polish Director of Mines appointed
	Hungary	---	---	Kond building proposed
	Bloc	1959	---	Exploration of iron-ore deposits
Iraq	USSR	1959	March	Improvement of river navigation Baghdad-Basra railroad Kirkuk-Sulaymaniyah railroad
		1959	---	Oil prospecting and seismic surveys
	Bloc	---	---	Scholarships for 600 students

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Recipient Country	Aid-Granting Country	Date Extended Year	Date Extended Month	Projects Receiving Aid
United Arab Republic				
Egypt	East Germany	1955	---	Electrification projects on Nile Delta
		1956	---	Electrification projects on Nile Delta
	USSR	1958	January	5 airfields in mining areas Central mineral research laboratory 20 chemical field laboratories Geological research and survey Geophysical work Organization of ilmenite production Manganese-ore production, Elba fields Geological survey for lead and zinc deposits Development of Bakaria iron-ore mines 2 plants for separation of rare earths Geophysical exploration for petroleum
		1958	December	Aswan High Dam
Syria	Bulgaria	1957	First half	Airfield construction, Dumayr
		1957	Second half	Port development, Latakia
	USSR	1957	October	Euphrates River Basin Al Khabur Basin Ahab-Asharneh Basin Upper Orontes Basin Electrification of Orontes Basin Al Kabir Basin Barada Basin Yarmuk Basin Well drilling and water storage in arid regions Railroad projects Bridges Geophysical surveys

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Recipient Country	Aid-Granting Country	Date Extended Year	Date Extended Month	Projects Receiving Aid
Yemen	USSR	1956	July	Port construction, Ras-al-Kathib Airfield construction Mineral survey
	Communist China	1958	January	Road construction
Ceylon	USSR	1958	February	Hydroelectric power station and other irrigation facilities Malwattu irrigation dam design
India	USSR	1956	November	Coalfield development, Korba, Madhya Pradesh
		1960	February	Oil and gas exploration, development, and production
Indonesia	USSR	---	---	Roadbuilding, Kalimantan
		1959	June	Merchant marine academy, Amboina
		1960	---	Oceanographic institute, Amboina
Nepal	Communist China	1959	April	East-West roadbuilding survey
Iceland	Czechoslovakia	1956	January	Hydroelectric units and power transformer stations
Greece	Rumania	1959	---	Oil prospecting
Various	Bloc	1956-59	---	Training for 1,860 academic and 1,895 technical students

Adapted from: EIC-R14-S8, 29 Feb 1960, Sino-Soviet Bloc Economic Aid to Underdeveloped Areas: 1 July-31 December 1960, p. 92-108 [redacted] 25X1